REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

AD-A240 727

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	2. REPORT DATE July 1991	3. REPORT TYPE AND DATE COVERED Journal Article 1991
4. TITLE AND SUBTITLE Can Accidents be Predicted? An Empirical Test of the Cognitive Failures Questionnaire		5. FUNDING NUMBERS None
6. AUTHOR(S) G. E. Larson, C. R. Merrit		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Navy Personnel Research and Development Center San Diego, California 92152-6800		8. PERFORMING ORGANIZATION JA-91-09
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING/MONITORING Applied Psychology: An International Review, 40(1), pp. 37-45, 1991
11. SUPPLEMENTARY NOTES		
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE A

13. ABSTRACT *(Maximum 200 words)*

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91-11463

14. SUBJECT TERMS accidents; cognitive failures questionnaire; vehicle operation; driver safety; validity			15. NUMBER OF PAGES 8
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED

NSN 7540-01-280-5500

91 9 25 016

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

APPLIED PSYCHOLOGY: AN INTERNATIONAL REVIEW, 1991, 40 (1), 37–45

Can Accidents be Predicted? An Empirical Test of the Cognitive Failures Questionnaire

Gerald E. Larson and Charles R. Merritt

Testing Systems Department, Navy Personnel Research and Development Centre, San Diego, California, U.S.A.

Cent cinquante neuf jeunes gens remplirent un questionnaire dans le but d'évaluer la fréquence de diverses erreurs mentales banales. Les réponses au questionnaire furent alors comparées aux dossiers de chauffeur des sujets. Ceux qui obtenaient le plus d'erreurs mentales, devaient probablement être aussi ceux qui avaient causé des accidents de circulation, mais la corrélation apparut seulement après l'exclusion de ceux des sujets qui avaient des dossiers de chauffeur remarquablement mauvais. Dans un deuxième groupe de cent cinquante deux hommes, les réponses au questionnaire différenciaient également ces sujets qui avaient causé des accidents de ceux qui ne l'avait pas fait.

A total of 159 young men filled out a questionnaire designed to assess the frequency of various common mental slips. Their responses were then compared with the driving records of the respondents. Those subjects reporting more mental slips were also more likely to have caused traffic accidents, but the relationship only emerged following exclusion of those subjects with remarkably bad driving records. In a second group of 152 men, questionnaire responses again differentiated those subjects who had caused accidents from those who had not.

INTRODUCTION

The phrase "accidents will happen" summarises the old fact that costly mistakes are a ubiquitous aspect of life. A somewhat more modern line of thought, however, holds that (1) catastrophic errors and trivial, everyday mental slips may reflect similar breakdowns in cognitive processing

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Requests for reprints should be addressed to Gerald E. Larson, Testing Systems Department, Navy Personnel Research and Development Centre, San Diego, California 92152, U.S.A.

The opinions expressed in this paper are those of the authors, are not official, and do not necessarily reflect the views of the Navy Department.

A-1 20

(Reason, 1988), and that (2) such processing breakdowns are related to a general trait, such as a propensity to cognitive failure (Broadbent, Cooper, Fitzgerald, & Parks, 1982; Reason, 1988). Thus, individuals who often, for example, drop things or forget appointments, may also have a greater probability of causing vehicle collisions, industrial accidents, and the like.

If common and catastrophic errors do, indeed, jointly reflect an underlying dimension on which substantial individual differences exist, questionnaires designed to assess the frequency of common mental slips should predict grosser errors of judgement that cause accidents and, more importantly, provide a screening measure for occupations with high accident rates. In this paper, we present data showing that young men with a history of traffic accidents also reported higher rates of common mental errors than a group of accident-free peers. We then discuss the theoretical and practical implications of our findings.

EXPERIMENT 1

Method

The subjects in this study comprised 159 male Navy recruits, randomly selected from groups awaiting job classification interviews at the Recruit Training Command, San Diego, California. The subjects were part of a larger sample involved in a study to determine the test–retest reliability of a number of standard and experimental aptitude tests, the complete results of which are presented in a separate paper. The mean age of the full sample was 19.8 years, with a standard deviation of 2.6 years.

Cognitive Failures Questionnaire. The Cognitive Failures Questionnaire (CFQ) is a 25-item instrument developed by Broadbent et al. (1982) to assess the frequency of everyday slips and errors. Each item refers to a particular type of mistake (e.g. bumping into people, forgetting names), and subjects are asked to indicate, on a 5-point scale, how often they commit that particular error. The scale points are anchored by the following descriptors: "very often", "quite often", "occasionally", "very rarely" and "never".

The CFQ appears to provide unique information, in that, at best, it is only weakly related to standard personality and intelligence scales (Broadbent et al., 1982). In order to determine the CFQ's reliability in the present sample, the questionnaire was administered twice, with approximately 1 month in between. The CFQ was randomly administered either first or last relative to the other tasks undertaken by the subjects.

Intelligence Tests. Intelligence scores are provided for two reasons: (1) to verify that intelligence and propensity to cognitive failure are independent dimensions, and (2) to determine whether general intellectual ability might itself be a predictor of accidents. Some studies have shown a relationship between measured intelligence and automobile accidents (e.g. Harrington, 1971), whereas others have not (e.g. Guilford, 1973; McKenna, Duncan, & Brown, 1986). Smith and Kirkham (1982) and McKenna et al. (1986) identify methodological problems with much of this work. Regardless, it is certainly true that no consensus on the relationship between traffic accidents and intelligence has emerged.

Two measures of general intelligence are reported in the present study: (1) the Ravens Advanced Progressive Matrices (RPM) (Raven, 1962) and (2) the Armed Forces Qualifying Test (AFQT). The AFQT is used to determine the general mental ability (or trainability) of military accessions. The RPM and AFQT were correlated 0.49 ($P < 0.001$) in the present sample.

Accident Data. The subjects were asked two questions related to their driving records: (1) "How many traffic tickets for moving violations have you received?" and (2) "How many times have you been cited for causing a traffic accident?" Of the two traffic measures, we considered it more likely that the CFQ would predict accidents, because tickets might often stem from the *deliberate* actions of the subject (e.g. speeding so as not to be late for work), and might therefore not reflect "mishaps" in the sense of unintended mistakes.

Results

Descriptive statistics for the variables in the study appear in Table 1. The information volunteered regarding driving mishaps appears generally honest, as a spot comparison of subjects' responses with actual traffic records in military personnel files revealed an extremely high level of agreement. As can be seen, the average subject had received one traffic ticket and had

TABLE 1
Experiment 1: Descriptive Statistics for Variables

Variable	*Mean*	*S.D.*
CFQ	34.02	11.67
Raven	19.02	5.44
AFQT	57.44	19.67
Tickets	1.04	1.76
Accidents	0.13	0.43

not been cited for causing a traffic accident. What is noteworthy, however, are the extremes in this sample. Two subjects had received more than nine tickets (though nine was used as the ceiling in our records), one of whom had also had three accidents, which was the most in the sample. When grouped dichotomously, 70 of the 159 subjects (44%) had received one or more traffic tickets, while 14 subjects (~9% of the sample) had been cited for causing one or more accidents.

Preliminary analyses indicated that neither intelligence measure was correlated with accidents, or scores on the CFQ. Therefore, the analyses that follow focus on the main hypothesis of the study, i.e. that CFQ scores might predict driving mishaps. Student's t-tests were performed to determine whether the "ticket/no ticket" or "accident/no accident" groups differed on CFQ scores. The results are presented in Table 2. No significant differences emerged between those who had received tickets or caused accidents and those who had not.

TABLE 2
Experiment 1: Student's t-tests for Ticket and Accident Data

	Tickets (n = 70)		No Tickets (n = 89)		t-test	
	Mean	*S.D.*	*Mean*	*S.D.*	t	*Prob.*
CFQ	35.0	10.6	33.3	12.4	−0.91	N.S.
	Accidents (n = 15)		No Accidents (n = 144)		t-test	
	Mean	*S.D.*	*Mean*	*S.D.*	t	*Prob.*
CFQ	39.0	11.6	33.5	12.0	−1.75	N.S.

To determine whether or not these results might be skewed by the extreme cases noted above, the subjects whose total tickets exceeded the sample mean by more than 4 standard deviations were excluded. Three subjects with eight or more tickets were thus dropped, and the analyses re-run. Again, no significant differences emerged between those who had received tickets and those who had not. As noted above, this is not entirely surprising, because tickets often stem from the deliberate or planned actions of the individual. For the accident data, however, those subjects who had been cited for causing accidents had significantly higher scores on the CFQ than did their accident-free peers (Table 3). In other words, accident-prone subjects were also more error-prone in their everyday lives.

TABLE 3
Experiment 1: Student's t-tests for Ticket and Accident Data, Following Exclusion of Extreme Cases

	Tickets (n = 67)		No Tickets (n = 89)		t-test	
	Mean	*S.D.*	*Mean*	*S.D.*	t	*Prob.*
CFQ	35.2	10.7	33.3	12.4	−1.02	N.S.
	Accidents (n = 14)		No Accidents (n = 142)		t-test	
	Mean	*S.D.*	*Mean*	*S.D.*	t	*Prob.*
CFQ	40.4	11.0	33.5	11.6	−2.14	0.034

Finally, we note that the CFQ had a test–retest reliability of 0.78 in the present sample.

EXPERIMENT 2

Because the CFQ/accident relationship only emerged following the exclusion of those subjects with remarkably bad driving records, one must wonder how much confidence should be placed in this finding. To determine whether the results could be replicated, a second experiment was conducted on an independent sample.

Method

The subjects in the second study comprised 152 male Navy recruits, randomly selected (as in Experiment 1) from groups awaiting job classification interviews at the Recruit Training Command, San Diego, California. The subjects filled out CFQ's identical to those used in Experiment 1, including the two questions related to driving records: (1) "How many traffic tickets for moving violations have you received?" and (2) "How many times have you been cited for causing a traffic accident?"

Results

Descriptive statistics for the variables in the study appear in Table 4. As can be seen, the average subject had received slightly less than two traffic tickets and had not been cited for causing a traffic accident. When grouped dichotomously, 86 of the 152 subjects (57%) had received one or more

TABLE 4
Experiment 2: Descriptive Statistics for Variables

Variable	Mean	S.D.
CFQ	38.03	12.91
Tickets	1.62	2.16
Accidents	0.15	0.39

TABLE 5
Experiment 2: Student's t-tests for Ticket and Accident Data

	Tickets (n = 86)		No Tickets (n = 66)		t-test	
	Mean	S.D.	Mean	S.D.	t	Prob.
CFQ	38.2	12.9	37.8	13.1	−0.20	N.S.
	Accidents (n = 20)		No Accidents (n = 132)		t-test	
	Mean	S.D.	Mean	S.D.	t	Prob.
CFQ	43.7	16.1	37.2	12.2	−2.13	0.035

TABLE 6
Experiment 2: Student's t-tests for Ticket and Accident Data, Following Exclusion of Extreme Cases

	Tickets (n = 81)		No Tickets (n = 66)		t-test	
	Mean	S.D.	Mean	S.D.	t	Prob.
CFQ	38.2	12.9	37.8	13.1	−0.21	N.S.
	Accidents (n = 19)		No Accidents (n = 128)		t-test	
	Mean	S.D.	Mean	S.D.	t	Prob.
CFQ	44.0	16.4	37.2	12.2	−2.18	0.031

traffic tickets, while 20 subjects (~13%) had been cited for causing one or more accidents. In general, these subjects seem to be somewhat worse drivers than the subjects in Experiment 1.

Student's t-tests were performed to determine whether the "ticket/no ticket" or "accident/no accident" groups differed on CFQ scores. The results are presented in Table 5. No significant differences emerged between those who had received tickets and those who had not. However, those subjects who had been cited for causing an accident had significantly higher CFQ scores than did their accident-free peers. To completely replicate Experiment 1's analyses, we excluded subjects with eight or more tickets ($n = 5$) and then re-ran the analyses. The results are shown in Table 6. Again, no significant differences emerged between those who had received tickets and those who had not. For the accident data, however, those subjects who had been cited for causing accidents still had significantly higher scores on the CFQ than did their accident-free peers.

DISCUSSION

Our results indicate that, with certain qualifications, frequency of minor mental slips can be reliably measured, and related to external criteria of substantial social cost, such as traffic accidents. The main qualification is that extreme rates of driving mishaps were not predicted in Experiment 1. Given that our sample involved young men, this rare, nearly pathological driving style may instead be a function of thrill seeking, machismo or other dimensions beyond the scope of the present paper. The distinction between accidents following inattention and accidents following *deliberate* recklessness is theoretically important and will undoubtedly remain a concern for studies of this type. For example, if follow-up research were to use industrial accidents as a criteria, *some* incidents should not be predicted by the CFQ if they stem from sabotage rather than absent-minded "blind mishaps".

To recognise that "true" cognitive failures are unintended also helps us fit this construct within broader theories of attention and intelligence. Theories of attention, for example, commonly distinguish between automatic and control processes. Automatic processing is a fast, parallel and effortless process that is not limited by short-term memory capacity, whereas control processing is a slow, generally serial, effortful, capacity-limited processing mode that requires substantial self-monitoring and subject regulation (Schneider, Dumais, & Shiffrin, 1984). Reason (1984) has linked mental slips to automatic processing, saying that slips occur under relatively uniform conditions: "during the execution of some automatized task in a familiar setting in which attention has been claimed by some internal preoccupation or some external distraction" (p. 574).

"Intelligence", on the other hand, is theoretically linked to intentional, resource-demanding control processes (Ackerman, 1986) and the limited information-handling capacities of short-term or working memory (Larson & Saccuzzo, 1989). It is thus not surprising that intelligence was uncorrelated with CFQ scores in Experiment 1 (see also Broadbent et al., 1982).

To reiterate, mental slips seem logically and empirically unrelated to focused attention or performance on cognitive tasks (such as intelligence tests) where concentrated effort is required (Martin & Jones, 1983). In contrast, the CFQ does appear related to performance on distributed attention tasks (Harris & Wilkins, 1982; Martin & Jones, 1983). As Reason (1988) has suggested, the CFQ may thus measure some qualitative aspect of attentional deployment, rather than attentional capacity. His review, in fact, suggests that high CFQ scores may reflect a cognitive management style of inflexible attentional focus. Such inflexibility could leave concurrent activities unmonitored and thereby susceptible to breakdowns or errors. If so, then the present finding of a link between high CFQ scores and traffic accidents can be explained as follows: The high score suggests a locked, rigid mental focus, which leaves the driver unaware of dynamic road conditions or hazards.

Though more work at the construct level is clearly needed, we wish to close by returning to the practical implications of our data. In 1985, accidents cost America US$107.3 billion, 92,500 lives and 9,000,000 disabling injuries (National Safety Council, 1986). Tragically, it has been estimated that approximately 70% of aviation accidents (Feggetter, 1982) and 90% of accidents in general are attributable to human error. Examples abound. The 1977 collision of two jumbo jets in Tenerife, Canary Islands, which killed 583 people, stemmed from the captain's simple neglect to get take-off clearance. In 1979, Three Mile Island became a household word after maintenance workers, having performed routine cleaning, mistakingly left a coolant valve closed. Can the incidence of such catastrophies be reduced by more careful employee screening? In closing, we pick no quarrel with the phrase "accidents will happen". Rather, we think it wise to add, "but to whom?"

Manuscript received May 1989
Revised manuscript received December 1989

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